(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 209 877 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 158(3) EPC

(43) Date of publication:
29.05.2002 Bulletin 2002/22

(21) Application number: 01943867.0

(22) Date of filing: 28.06.2001

(51) Int Cl.[7]: H04L 29/08, H04L 12/28, H04B 7/26

(86) International application number:
PCT/JP01/05570

(87) International publication number:
WO 02/05516 (17.01.2002 Gazette 2002/03)

(84) Designated Contracting States:
DE FR GB

(30) Priority: 06.07.2000 JP 2000204623

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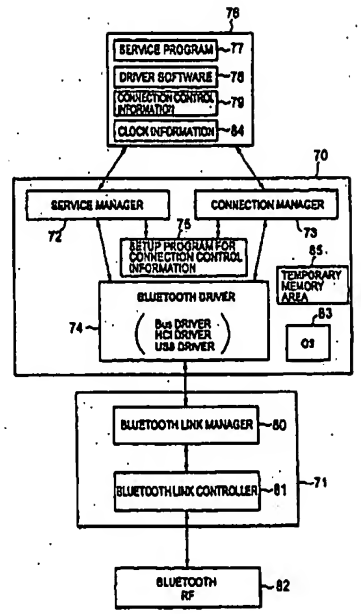
(54) COMMUNICATION UNIT AND ITS CONTROLLING METHOD

(57) Apparatus and method for improving communication performance of a radio communication system are provided. The radio communication system can load or unload service information at appropriate timings by flexibly designating conditions for determining a connection or disconnection of a radio link.

Service manager 72 reads out necessary service information, such as service program 77 or driver software 78, from information memory area 76 based on determination conditions designated in communication controlling information of the communication status and loads to temporary memory 85 in host 70. Service manager unloads unnecessary service information from temporary memory area 85 in the host. Connection manager 73 performs connection for communicating between the service information loaded in temporary memory area 85 and the service information of target device.

FIG.7



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Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field of the Invention

[0001] The present invention relates to a communication device and a method for controlling the communication device, and more particularly related to a radio communication device and a method for control thereof.

Background technology

[0002] In the case where peripheral devices or extension cards are connected to a personal computer (PC), the PC is loaded with a suitable driver software for the respective devices so that it may recognize hardware information for the additional devices. Moreover, the PC may further allocate various resources, such as an I/O port, by using the plug and play technology. In plug and play technology, the driver software corresponding to the additional devices and other related service programs are loaded. The PC determines whether to load or unload the device software and service programs by detecting the device connection to the PC through a direct bus connection or a cable wire connection.

[0003] Recently, radio communication techniques have been put to practical use in coupling between information devices. Radio communication techniques such as "Bluetooth" or Home RF are being used in coupling, for example, a PC and a Personal Digital Assistance (PDA); or a PC and a mobile telephone.

[0004] Bluetooth is a radio communication interface standard that uses an Industrial Scientific Medical (ISM) band of 2.4 GHz as a carrier frequency and provides a band zone of 1 Mbps within around 10 m service area.

[0005] Similar to Bluetooth, Home RF is also a radio communication standard for a home application. Home RF uses the same ISM band of 2.4 GHz as a carrier frequency and communicates through the maximum data transmission speed of 1.6 Mbps in a service area covering a distance from 50 m to 100 m.

[0006] In the prior radio communication systems discussed above, a connection or a disconnection between a master device and a slave device may frequently occur when the radio state becomes unstable due to the surrounding environment. During each connection or disconnection, a host PC in the radio communication system may experience an increases in loads because of the repetitious loading and unloading, for example, of service information such as driver software or service programs. Consequently, the host results in a number of problems that hinder performance. Unintended communications generated by a user of the PC due to an unexpected loading of service information, for example, causes excessive loads on the communication operations of the host PC. Further, unintended unloading of service information by an user may prevent the host PC from communicating service information to the peripheral device.

[0007] Japanese patent application publication No. 11-355279, discloses technology that controls data communication in a radio communication system based on a corresponding link status of the radio communication system. The link status is determined by monitoring data communication between two devices of the radio communication system. Based on the number of frames corresponding to decoded managing data, the disclosed technology determines whether the communication environment is an all data transmittable area, an asynchronous transmittable area, or a transmission unable area. Identifying the type of communication environment enables the host PC to determine whether the radio communication system has a link possible status, a link impossible status, or a link possible status for only asynchronous data that are performed during a retransmission process.

[0008] As described above, a conventional radio communication system has a serious problem that reduced performance in its communication process because of the repeated loading and unloading of service information, which corresponds to a radio link state of the radio communication system. The technology disclosed in the Japanese patent application publication No. 11-355279 may increase the reliability of data communication. However, this technology can not solve the problem of reduced communication performances attribute to unintentional loading or unloading of service information.

[0009] To overcome the above problems and other disadvantages of the prior art, methods and systems consistent with the present invention control a communication device to load or unload service information at appropriate timings by flexibly designating discriminating conditions on a link connection or a link disconnection in order to secure a stable radio communication system.

Disclosure of the Invnetion

[0010] An embodiment consistent with the present invention relates to a communication device on a network for communicating with a target communication terminal on the network. The communication device is characterized in that it comprises a memory for storing service information so that perform predetermined functions can be performed over the network with the target communication terminal; a judging module for judging whether predetermined connection conditions with the target communication terminal are satisfied by repeating a target communication terminal discovery process before establishing radio communication with another target communication terminal; and a communication control module for executing the predetermined functions with the target communication terminal by reading service information associated with the target communication terminal from the service information memory when the predetermined connecting conditions are satisfied.

[0011] According to the communication device consistent with the present invention, when the communication device is connected with a new target communication terminal, the communication device repeats a target terminal discovery process for determining whether connection discriminating conditions are satisfied. Thus, it can reduce unnecessary communication of service information when a target communication terminal just temporarily approaches close to a communication area for the communication device without any intention to connect to the communication device. Consequently, the communication device consistent with the present invention can improve performance of the communication process by eliminating the unnecessary loading of service information in the communication system.

[0012] Another embodiment consistent with the invention also relates to a radio communication device on a network for communicating with a target communication terminal on the network. The radio communication device comprises a service information memory for storing service information that corresponds to the target communication terminal so that predetermined functions can bo performed with the target communication terminal over the network; a judging module for judging whether predetermined disconnection discriminating conditions are satisfied by repeating a connection process with the target communication terminal before disconnecting radio communication with the target communication terminal; and a communication control module for invalidating the predetermined functions associated with the service information that corresponds to the target communication terminal and storing service information in the service information memory when the predetermined disconnection discriminating conditions are satisfied.

[0013] According to this configuration, the radio communication device consistent with the invention can continuously secure a link for the radio communication even if the target communication terminal has temporarily moved apart from the communication area for the communication device, insofar as the disconnection discriminating conditions are satisfied. Consequently, the radio communication device can avoid an unintentional disconnection process of the service information. This is possible to provide a stable radio communication environment for a user.

[0014] A further embodiment consistent with the present invention relates to a communication device in a network for communication with a target communication terminal in the network. The radio communication device includes a service information memory for storing service information so that predetermined functions can be performed with the target communication terminal, and a communication control module for communicating with the target communication terminal by using the service information read out from the service information memory based on communication controlling information that defines discriminating conditions for establishing a new radio communication connection with the target communication terminal or disconnecting an existing connection with the target communication terminal.

[0015] According to this radio communication device, it becomes possible to improve a performance for the communicating process with the target communication terminal with avoiding any increases of the loading of the communication loads because the device communicates service information to the target terminal based on a discrimination result as to whether a connection or a disconnection status of the radio link between the radio communication device and the target communication terminal corresponds to the preliminary defined communication control information, it can eliminate communication of service information in accompanying to the undesired link connection/disconnection by a user.

[0016] Further, the communication device consistent with the invention can communicate service information much more flexibly because it becomes possible for a user to setup a condition for each of devices. Thus, Yet a further embodiment consistent with the present invention relates to a communication device comprising a radio communication module for exchanging data with a target communication terminal through radio; a service information memory for storing service information so that predetermined functions can be performed with a target terminal; a temporary memory for temporarily storing service information used in an established target communication terminal for communication; a designating module for designating communication controlling information in order to define conditions for discriminating between a newly established radio-communication connection with the target communication terminal or a disconnection of an existing radio communication connection with the target communication terminal; a communication controlling information memory for storing the communication controlling information designated by the designating module; a distinguishing module for determining whether a status of the radio communications connection with a target communication terminal is a connection status or a disconnection status based on the communication controlling information in the communication controlling information memory, and transferring the service information from the service memory to the temporary memory when the status of the radio communication connection with the target communication terminal is the connection status, and transferring the service information from the temporary memory to the service memory when the status of the radio communication connection with the target communication terminal is the disconnection status; and a radio communication control module for performing the predetermined functions with the target communication when the service information is stored in the temporary memory.

[0017] A further embodiment consistent with this invention relates to a communication device comprising a radio communication module for exchanging data with a target communication terminal through a radio; a service memory for storing service information so predetermined functions can be performed with the target communication terminal; a temporary memory for temporarily storing service information used in an established target communication terminal for communication; a communication controlling information memory for storing the communication controlling information designated by the designating module for determining whether a status of the radio communication connection with the target communication terminal is a connection status or a disconnection status based on the communication controlling information in the communication controlling information memory, and transferring the service information from the service memory to the temporary memory when the status of the radio communication connection is the connection status, and transferring the service information from the temporary memory to the service memory when the status of the communication connection with the partner terminal is the disconnection status; and a radio communication control module for performing the predetermined functions with the target communication terminal when the service information is stored in the temporary memory.

[0018] In a communication device consistent with the invention, the service information is transferred to the temporary memory based on a judging result whether a connection status or a disconnection status of a radio link between the communication device and the target communication terminal that corresponds to a preliminarily defined communication control information. Consequently, it is not necessary to perform transferring the service information in each unintentional connection or disconnection generated by a user. Thus, the communication device consistent with the invention can improve a performance for the communication processing with eliminating unnecessary transferring operations of the service information.

Brief Description of the Drawings

[0019]

Figure 1 is a block diagram illustrating a general structure of a radio-communications system consistent with the invention.

Figure 2 is a block diagram illustrating a general structure of a complete radio-communications system consistent with the invention.

Figure 3 is a block diagram illustrating a hardware structure of a personal computer used as information processing equipment consistent with the invention.

Figure 4 is a block diagram illustrating a software structure of a personal computer consistent with the invention.

Figure 5 is a block diagram illustrating a hardware structure of mobile telephone consistent with the invention.

Figure 6 is a block diagram illustrating a software structure of mobile telephone consistent with the invention.

Figure 7 is a block diagram illustrating a structure of a host and a host controller consistent with the invention.

Figure 8 a block diagram illustrating a connection/disconnection state of a radio link consistent with the invention.

Figure 9 is a flowchart showing a connection judging process radio link consistent with the invention.

Figure 10 is a flowchart showing a disconnection judging process radio link consistent with the invention.

Figure 11 illustrates an example of a connection/disconnection setup state of a radio link consistent with the invention.

Figure 12 illustrates an example of user interface screen for designating connection/disconnection conditions for a radio link consistent with the invention.

Practical Configuration of the Invention

[0020] Hereafter, exemplary embodiments of the invention are explained with reference to the accompanying drawings.

[0021] Fig. 1 illustrates a basic structure of a radio-communication network in accordance with an embodiment consistent with the invention. Generally, the radio communication system comprises information processing equipment and a mobile apparatus. The information processing equipment may be represented, for example, by a battery driven notebook type personal computer (PC 1). The mobile apparatus may be represented by a mobile telephone 2. PC1 and the mobile telephone 2 may communicate information by establishing a local radio link. When a radio link is established between PC1 and the mobile telephone 2, a user may perform predetermined service programs on radio communication network, such as mailing data or exchanging personal information.

[0022] PC1 may establish a radio link between a plurality of device on radio communication network at the same time. For example, PC1 may exploit a multi-point access technique by connecting to mobile telephone 2 and at least one PC device in the network. In the multi-point access technique, even if PC1 is in a radio link state in which a connection has already been established, PC1 may enter to one of a number of operational modes. Particularly, PC1 may enter a station discovery mode to search a new target terminal, a waiting mode for the station discovery, or a waiting mode to demand an established connection to a discovered target termi-

nal on the network. Thus, the multi-access technique enables a new target terminal to dynamically connect to the network.

[0023] The station discovery mode enables PC1 to search a target terminal that is located in a communication range of PC1, and collect information required for connection to the target terminal over network. In the station discovery mode, PC 1 broadcasts a message that indicates a station discovery. The waiting mode for a station discovery enables PC1 to detect a station discovery message transmitted from a target terminal for a station search. PC1 transmits a message in response to the station discovery message of the target node. The waiting mode for demanding establishment of a connection enables PC1 to detect a demand for connection establishment message transmitted from a target terminal. PC1 performs a process in response to the demand of connection establishment message of the target terminal.

[0024] PC1 executes one of the operation motioned mentioned above to establish a new radio line to a target terminal on network. The station discovery mode, waiting for the station discovery mode and waiting for a demand of connection establishment mode allow PC1 to transfer messages over a control channel. However, when transmitting and receiving data, PC1 uses a radio resource between the control channel and a communication channel. Consequently, if PC1 executes a control process while also communicating with a target device, PC 1 temporarily suspend the communication with the target device. PC1 dynamically controls execution timings and intervals of control procedures based on conditions designated by a user. Particularly, PC1 executes station discovery mode, waiting for the station discovery mode, and waiting for a demand of connection establishment for establishing a new radio link on network. PC1 further executes the station connection demand mode to disconnect a radio link with a target device on the network.

[0025] With reference to Fig. 2. a general structure of a complete radio-communication network in accordance with an embodiment consistent with the present invention is explained. Radio communications network includes PC1, mobile telephone 2, a mobile phone base station 3, a public link network 4, and a server 5. PC1 further includes an LCD(not shown) for displaying data and a keyboard for inputting data(not shown).

[0026] Mobile telephone 2 includes a mobile phone antenna unit for exchanging information with the mobile phone base station 3 over an 800 MHz radio wave of network. Mobile telephone further includes a radio antenna unit 34 for exchanging information with PC1 over a 2.45 GHz radio wave. Mobile phone base station 3 represents a predetermined radio area and facilitates communications from a portable telephone 2 located within the predetermined radio area. Public line network 4 connects mobile phone base station 3 to a server 5.

[0027] Mobile telephone 2 performs transmission and reception of sound and data between mobile phone base station 3. Mobile phone base station 3 constitutes a predetermined radio area, and realizes communication with a portable telephone 2 within the radio area over the 800 MHz radio wave. Mobile phone base station 3 connects to server 5 through a public line network 4. PC1 and the mobile telephone 2 are coupled by radio wave of a specific frequency band different from the radio wave used for communication in the mobile phone system. Practically, the Bluetooth system of 2.45 GHz band is used for coupling between the PC1 and the mobile phone 2. Mobile telephone 2 also includes a LCD for displaying data and a key operation unit for inputting and data. The Bluetooth system is a short-distance communication standard for realizing radio communications around 10 m by using an electric wave of 2.45 GHz band.

[0028] PC1 and the mobile telephone 2 are coupled by a radio wave of a specific frequency band different from the radio wave used for communication in the mobile-phone system. Practically, Bluetooth system of 2.45GHz band is used for the coupling between the PC1 and the mobile telephone 2. The Bluetooth system is a short-distance radio-communications standard for realizing radio communications around 10 m by using an electric wave of 2.45 GHz band.

[0029] Fig. 3 is a block diagram illustrating a hardware structure of PC1 in accordance with an embodiment consistent with the invention. PC1 includes a radio module 7 having an antenna unit 8, a Radio Frequency (RF) unit 9, a base band unit 10, a memory unit 11, a crystal oscillation unit 12, an AD/DA conversion unit 13, and a microphone/speaker unit 14. PC1 also includes an engine unit 15 having a mathematical processing unit (MPU) 17, a hard disk drive (HDD) 18, a light emitting diode (LED) 19, a Universal Serial Bus (USB) 20, a LCD 21, a keyboard 22 and a personal computer memory card international association (PCMCIA) interface 23. Radio module 7 communicates data with a mobile telephone 2 over the 2.45 GHz band radio wave on network. Engine unit 15 provides an interface to users and other peripheral devices of network.

[0030] Antenna unit 8 exchanges information with mobile telephone 2 over a2.45 GHz band radio wave. For illustrative purposes, antenna unit 8 is assumed to receive a signal over radio communication network. When the antenna unit 8 receives a 2.45 GHz radio wave, RF unit 9 is connected to receive the radio wave on its input from antenna unit 8. RF unit 9 also connected to receive an input from crystal oscillation unit 12. RF unit 9 mixes the 2.45 GHz radio wave input from antenna unit 8 and a basic frequency signal input from crystal oscillation unit 12 and produces an intermediate frequency signal. RF unit decodes the intermediate frequency signal and generates a digital signal. RF unit 9 outputs the digital signal to an input of base band unit 10. Base band unit 10 performs protocol processes. Thus, in this base band unit 10, the inputted signals

through the antenna unit 8 and the RF unit 9 are changed into the data sequences for processing by a CPU.

[0031] Alternatively, when antenna unit 8 transmits a 2.45 GHz radio wave, RF unit 9 is connected to receive an input from base band unit 10 and an input from crystal oscillation unit 12. RF part 9 modulates the signals received from base band unit 10 with the base band signal received from crystal oscillation unit 12 to generates a 2.45 GHz radio wave. RF unit 9 provides the 2.45 GHz radio wave on its output to antenna unit 8.

[0032] Microphone/speaker unit 14 receives or outputs audio information. When receiving audio information, microphone/speaker unit 14 is connected to provide the received audio signal on its output to AD/DA conversion unit 13. When outputting audio information, microphone/speaker unit 14 is connected to receive an audio signal on its input from AD/DA conversion unit 13. Microphone/speaker unit 14 then outputs the received audio signal.

[0033] MPU 17 includes among other things a CPU, a memory, peripheral and a peripheral control circuits. When antenna 8 receives a 2.45 GHz radio wave, MPU 17 is connected to receive an input from base band unit 10 through serial interface 16 and provide an output to at least one of HDD 18, LED 19, USB 20, LCD 21 or PCMCIA 23. Alternatively, when antenna 8 transmits a 2.45 GHz radio wave, MPU 17 is connected to receive an input from one of HDD 18, LED 19, USB 20, LCD 21 or PCMCIA 23. MPU 17 then provides a signal to base band unit 10 through serial interface 16.

[0034] Fig. 4 is a block diagram illustrating a software structure of PC1 in accordance with the invention. Because hardware components of PC1 have been previously discussed, only the software components will be described below. PC1 includes radio module 7 having RF unit 9, base band unit 10, a Link Management Protocol (LMP) unit 25, and a Host Control Interface (HCI) 26. PC1 also includes engine unit 15 having an operation system (OS) 27, driver software 28, service programs 29, a radio protocol stack 30, an HCI 31, and clock control information 32. Fig. 4 shows a structure in which a radio protocol stack 30 for using radio communications of 2.45 GHz band is mounted in the engine unit 15 side of the personal computer.

[0035] As shown in Fig. 4, PC1 in radio module 7 includes RF unit 9 and base band unit 10. The radio module 7 further includes LMP 25 and HCI 26 on base band unit 10. LMP 25 is configured to monitor an output of base band unit 10. LMP 25 controls a radio link between PC1 and other radio-communication equipment on network. HCI 26 provides a serial interface between the software components of engine unit 15 in PC 1 and LMP 25.

[0036] PC 1 mounts Operating System (OS) 27 in engine unit 15, various service programs 29, such as, driver software 28 for controlling various peripheral devices, word-processing software, spreadsheet software, electronic mail software, and system software for realizing remote-control functions. Engine unit 15 further mounts radio protocol stack 30 and HCI 31. Radio protocol stack 30 is configured to control communication over 2.45 GHz frequency band by storing information received through HCI 31. HCI 31 provides a serial interface between the software components of radio module 7. Radio protocol stack 30 further includes clock control information 32 for deciding timing for a process.

[0037] Fig. 5 is a block diagram illustrating a hardware structure of mobile telephone 2 in accordance with an embodiment consistent with the present invention.

[0038] Mobile telephone 2 includes a radio module 33 having a radio antenna unit 34, an radio RF unit 35, a radio base band unit 36, which includes a clock control unit 37 and a serial interface 41, a memory unit 38, and a crystal oscillation unit 39. Radio module 33 communicates with PC1 over a 2.45 GHz radio wave. Serial interface 41 in radio module unit 33 is connected to engine unit in mobile telephone 2.

[0039] Radio antenna unit 34 transmits and receives a 2.45 GHz radio wave over a radio link for communicating with PC1. Radio antenna unit 34 provides the received radio wave on its output to radio RF unit 35. Radio RF unit 35 modulates the received radio wave from radio antenna unit 34 with the basic band signal received from crystal oscillation unit 39, to convert the radio wave into an intermediate frequency signal. Following the conversion, radio RF unit 35 demodulates the intermediate signal to generate a digital signal. Radio RF unit 35 provides the digital signal on its output to radio base band unit 36.

[0040] Radio base band unit 36 is connected to receive a digital signal output from radio RF unit 35. Radio base band unit 36 is also connected to receive a signal output from memory unit 38. The signals provided from radio RF unit 35 are changed into data sequence so as to be processed in the CPU. Base band unit 36 includes clock control unit 37 for deciding various timings.

[0041] Alternatively, when mobile telephone unit 2 desires to transmit a radio wave over radio communication network, radio base band unit 36 receives a data sequence from the telephone engine unit 40. Radio base band unit 36 performs the reverse of the operations described above, and provides a digital signal on its output to radio RF unit 35. RF unit 35 modulates the digital signal and transmits it over a 2.45 GHz radio wave through antenna unit 34.

[0042] The components of mobile phone engine unit 40 will now be discussed. Mobile phone antenna unit 42 communicates with mobile phone base station 3. Mobile phone antenna unit 42 provides a received 800 MHz radio wave on its output to mobile phone RF unit 43. Mobile phone RF unit 43 provides a digital signal on its output to mobile phone base band unit 44. Mobile phone engine unit 40 further includes LCD 45, key operation unit 46, LED display 47, and memory unit 48. LCD 45 displays data. Key operation unit 46 inputs data. LED

47 displays a warning. Mobile telephone 2 further includes AD/DA conversion unit 50, microphone/speaker 51, and power supply unit 52 as a common unit 49.

[0043] Fig. 6 shows a block diagram illustrating a software configuration of mobile telephone 2 in accordance with an embodiment of the present invention. Mobile telephone 2 includes radio module 33 having software elements LMP 54 and HCI 54, and mobile phone engine unit 40 having software elements mobile telephone protocol stack 55 for communicating over a 2.45 GHz radio wave.

[0044] Mobile telephone 2 further includes RF unit 35 and base band unit 37. Base band unit 37 mounts LMP 53 and HCI 54. LMP 53 controls a radio link to PC 1. HCI 54 performs a serial interface process with mobile phone engine unit 40.

Mobile phone engine unit 40 includes RF unit 43, base band unit 44, and mobile phone protocol stack 55. Mobile phone engine unit 40 further includes service programs 56, radio protocol stack 57, and HCI 58. Service programs 56 include system software for realizing remote-control functions. Radio protocol stack 57 performs radio communications over a 2.45 GHz radio wave. HCI 58 performs a serial interface process with radio module 33. Mobile phone engine unit 40 further includes clock control information 59 for deciding process timings.

[0045] The features of an embodiment consistent with the invention that enables loading and unloading of service information processes are explained in detail below. In the discussion that follows it is assumed that Bluetooth is used as a radio-communications standard using a 2.45 GHz frequency band.

[0046] In the Bluetooth system, data transmission is achieved by a Time-Division Duplex (TDD) packet transmission of 625 microseconds per slot. Bluetooth uses a frequency hopping technique that changes a frequency for each transmitted packets. By using the same frequency hopping sequence, it becomes possible for one master to communicate with a maximum of seven slaves at the same time. A radio communication network configured in such a manner is known as a Piconet. Bluetooth further provides an asynchronous data channel (ACL: Asynchronous Connection Less) and a synchronous voice channel (SCO: Synchronus Connection Oriented) for data communication. The SCO can use up to three channels at once, each channel having a 64 Kbps per channel throughput.

[0047] In Bluetooth, when a source terminal requests to communicate with a target terminal, but does not know an address of the target terminal, the source terminal performs an inquiry for collecting information necessary to establish a connection. The inquiry is also referred to as a station discovery. While performing the inquiry, the source terminal may collect all device addresses and clock control information on all terminals that respond to the inquiry. Because of the responses, the source terminal may establish a connection by executing a Page process (demand for connection establishment) based on the information collected from the responding terminals. Further, a remote terminal that is discovered by the source terminal performs an Inquiry Scan (waiting for station discovery) to answer the inquiry message. Furthermore a remote terminal that is in a waiting state for a demand for connection establishment mode performs a Page Scan (waiting for a demand for connection establishment), to respond to the Page of the source terminal.

[0048] Fig. 7 illustrates a plurality of functional elements of PC1 that enable the Bluetooth system to be mounted in accordance with an embodiment consistent with the invention. For illustrative purposes, we assume that PC 1 is a host device. PC 1 memory includes an information memory domain 76 having a service program 77, driver software 78, connection control information79 and clock control information 84, and a host 70. The host 70 includes host OS 83, Bluetooth driver 74, service manager 72, connection manager 73, and set up programs 75. Bluetooth device in host controller 71 is connected to a USB device.

[0049] The host 70 and information memory domain 76 permanently reside at host PC 1. Host 70 and host controller 71 communicate with in accordance with the protocol set by HCI. Host controller 71 further includes Bluetooth link manager 80 and Bluetooth link controller 81. Bluetooth link manager 80 and Bluetooth link controller 71 control operations of the Bluetooth RF circuit 82.

[0050] Service manager 72 accesses information memory domain 76 to read service information, for example, service program 77 and driver software 78. Service manager 72 judges whether a radio communication with a mobile telephone 2 has certainly established. Connection manager 73 monitors a state of link connection with a target device based on an information supplies from Bluetooth driver 74.

[0051] Information memory domain 76 stores a service program 77, driver software 78, connection control information 79, and clock control information 84. Connection control information 79 defines detecting conditions for a state of link connection. Clock control information 84 decides various timings of operations. Service manager 72 may load service information, such as a service program 77 and driver software 78, to a temporary memory 85. Service manager 72 also may unload the service information from the temporary memory 85. Connection manager 73 connects the temporary memory 85 and the service information stored in a target device so that service information can be communicated.

[0052] Fig. 11 shows a chart illustrating the contents connection control information 79. Connection control information 79 includes a device address, a friendly name that is arbitrarily defined by a user to define a device, connection judging conditions, and disconnection judging conditions. Connection judging conditions de-

fine conditions for determining whether a host device establishes a radio link with a target device. The connection conditions includes a number of items (N) the same device issues Inquiry, an issue interval (TI) of Inquiry, and a number-of-times maintenance time (Tn = N x TI) expires before a response is detected, which is based on the Inquiry issue number-of-times (N) and the Inquiry issue interval (TI). Specifically, service manager loads service information when a response is detected before the predetermined number of times device detection is performed (i.e., after the number-of-times the maintenance time (Tn) ms has expired). If the loading time is shorter than the detected number-of-times the maintenance time (Tn) expires, then the loading process is determined to be unnecessary and is omitted. Host PC 1 determines that there is a low possibility for communication of the service information by establishing a radio link.

[0053] The disconnection judging conditions are conditions for determining whether host PC 1 disconnects a radio link with a target device. The disconnection judging conditions includes a number-of-times (M) a connection request for recovering the connection is issued after host PC 1 detects a disconnection of a radio link, an issue interval (TJ) of the connection request, and a number-of-times the maintenance time (Tm = M x TJ) expired before a response is detected, which is based on the number-of-times (M) a connection request is made and the connection request issue interval (TJ). Thus, even if host PC 1 disconnects a radio link once, it is possible for host PC 1 to reestablish a connection with the radio link when a response to a connection request is received within a predetermined number of times before the maintenance time expires. PC 1 may, therefore, restrain the number of times service information is loaded because of unnecessary radio link disconnection.

[0054] Figure 8 explains a connection/disconnection state of a radio link between PC1 and a mobile telephone 2 on network using Bluetooth technology. In Figure 8, a boundary 2 designates a range limit of radio wave transmitted from the PC1. A boundary 1 designates an area outside of the range limit of radio wave transmitted by PC 1. A boundary 3 designates an area inside of the range limit of radio wave transmitted by the PC1.

[0055] In a first example, it is assumed that mobile telephone 2 is initially located in an area outside of boundary 1. When the mobile telephone 2 is located a location outside of the boundary 2, a radio link between PC1 and mobile telephone 2 is not established because mobile telephone 2 is unable to answer a device detection (Inquiry) broadcast by PC 1 over radio connection network. Assuming, mobile telephone 2 moves along locus A when mobile telephone 2 crosses boundary 2, mobile telephone responds to the device detection (Inquiry). After receiving the response from mobile telephone 2, PC1 begins a connection judging process of the radio link. If the PC1 detects that the responses corresponding to each Inquiry occurs N numbers of times within a detection maintenance time (TI) ms, then PC1 loads service information, and further communicates with mobile telephone 2.

[0056] An analysis of the radio link will now be made assuming that mobile telephone 2 moves along a locus B. When traveling along locus B mobile telephone 2 initially moves toward PC1, but reverses direction so that it moves in a direction away from PC1. As previously stated, mobile telephone 2cannot establish a radio link when it is located outside of boundary 2, because PC 1 cannot receive a response to the Inquiry. However, PC 1 receives a response to the device detection (Inquiry) from mobile telephone 2 and establishes a radio link, when mobile telephone 2 moves in a direction towards PC 1 and crosses boundary 2. As a result, PC 1 begins a judging process to determine the connection state of the radio link. However, as shown in locus B, while PC1 judges the radio link, mobile telephone 2suddenly changes directions and moves away from PC 1, until is located outside of boundary 2. Because mobile telephone 2 cannot respond the device detection of PC1, when a predetermined number of responses to the device detection have not occurred within a specified time, PC 1 determines that connection conditions do not exist. Therefore, PC 1 does not perform a loading process of service information

[0057] In contrast, under the conventional process, when a mobile telephone 2 moves into a location within boundary 2, PC 1 begins loading service information. Moreover, when mobile telephone 2 moves to a location outside of boundary 2, PC 1 immediately unloads service information. As a result, PC 1 performs unnecessary loading and unloading of service information. PC 1 also performs excessive communications with mobile telephone 2. From the above discussion it is apparent that the conventional process decreases communication performance.

[0058] In a second example, it is assumed that mobile telephone 2 is initially located inside of boundary 3. Initially, PC 1 establishes a radio link because mobile telephone 2 is in a location within boundary 2. Assuming, now that mobile telephone 2 moves along a locus C, in a direction away from PC1, when mobile telephone 2 At first, it is in a state that the radio link has already established between PC1 crosses boundary 2, PC1 detects a disconnection of the radio link. As a result, PC1 transmits a connection request to the mobile telephone 2, indicating that the radio link is disconnected. PC1 monitors radio communication network to determine whether N responses are detected within a maintenance time (Tm) ms. However, because mobile telephone 2 is located outside of boundary 2, PC1 does not receive N response within the maintenance time. Thus, PC 1 disconnects the radio link. At the same time PC 1 disconnects the radio link, service manager of PC 1 unloads the service information. Before disconnection of the ra-

dio link, PC1 and mobile telephone 2 communicated the service information over radio network.

[0059] Analysis of the radio link between PC1 and mobile telephone 2 will now be made assuming that mobile telephone 2 travels in a direction shown by locus D. Initially, because mobile telephone 2 is located within boundary 2, PC1 establishes a radio link with mobile telephone 2. When the mobile telephone 2 moves in a direction away from PC1 to a location outside of boundary 2, PC1 detects a disconnection of the radio link. As a result, PC1 transmits a connection request to mobile telephone 2, indicating that the radio link is disconnected. PC1 monitors radio network for response from mobile telephone 2 to determine whether N responses are detected within a predetermined maintenance time (Tm) ms. If, however, mobile telephone 2 moves in a direction towards PC 1 to a location within boundary 2, mobile telephone 2 responds to the connection request of PC 1. Because PC1 detects a response within the predetermined maintenance time, PC 1 maintains the radio link.

[0060] Figures 9 and 10 shows a flow diagram illustrating the connection judging process and disconnection judging process, respectively, in a manner consistent with the present invention.

[0061] During the connection judging process shown in the flow chart of Fig. 9, service manager 72 of PC 1 sends an HCI command to host controller 71. Service manager 72 further performs an inquiry so that a device may be discovered on network. Service manager 72 acquires a device address, clock control information, and service demand information from a target device on network (S100). PC 1 then determines whether a detected target device address is registered into connection control information 79 of information memory domain 76 (S101). If PC 1 determines that the detected target device address is not registered in connection control information 79, then the connection judging process moves to S102. On the other hand, id PC 1 determines that the detected device address is registered in the connection control information 79, then the connection judging process moves to S105.

[0062] At S102, because the connection control information corresponding to the detected target device address is not registered, PC 1 asks a user whether connection conditions and disconnection conditions are required to be setup and registered. If a user answer "yes," PC1 performs an appropriate setup/registration process (S103). If a user answer "no," then PC 1 does not perform the setup process (S104) and default connection/disconnection conditions of network are associated with the detected target device and copied into connection control information 79. This process is performed so that the newly detected target device address is associated with at least standard connection conditions.

[0063] The process step performed at S103, is explained in further detail in Figure 12. Figure 12 illustrates an example of a condition set-up screen as displayed on LCD21 of PC1. Keyboard 22 enables a user to input the necessary data. A user may optionally input a friendly name of the device as an entry in the condition setup object. A user may indicate connection detecting condition set-up items including a number of times (N) of an inquiry should issue, an issue interval (Ti), and a detection number for the maintenance time (Tn). A user may also indicate disconnection detecting conditions setup items including a number-of-times a connection request should issue (M), an issue interval (Tj), and a detection number for a maintenance time (Tm).

[0064] Further, the condition set-up screen enables a user to indicate an inquiry detection mode, which allows the connection request detection interval to be fixed or variable. In Bluetooth, a user may also dynamically vary an issue interval of the inquiry or connection request. When a user sets a variable inquiry detection mode, thereby giving priority to the detection number of the maintenance time of detection number-of-times, a host device may connect or disconnect a radio link even when the number of issued inquiries fails to meet the predetermined level. Moreover, a user may give priority to the inquiry detection mode or the connection request mode by selecting a fixed state. When a user completes the condition setup, a "Registration " button may be selected so that an address may be assigned to the previously detected target device. Furthermore, selecting the "Registration " button saves the condition setup information in connection control information 79. If a user selects a "Cancellation" button, then processing is terminated without saving the contents set up on the screen. It is further possible to change the setup items of any devices selecting a triangle mark in the right column of the condition setup object field. This enables a user to select a detection device from a list of friendly names registered to each respective device in connection control information 79.

[0065] Returning now to Figure 9, at S105 the connection judging conditions based on the detected device address are read from connection control information 79, and the device discovery process continues based on the read conditions (S105). At step S106, the host device detects whether the number of times of inquiry is less than N. When the number of inquiry detection is not less than N, the process returns to S105. Alternately, when the number of times of inquiry detection reaches to the N times, it progress to the process of S107. At a time when the number of times of inquiry detection is less than N, processing progresses to S107. At S107, the host loads information from service program 77 or driver software 78 in information memory area 76 that corresponds to the service information demanded from the detected device to temporary memory area 85. As a result, the host device may communicate with the detected device side. By performing the above process, PC 1 prevents the unexpected loading of service information when mobile telephone 2 enters a communication area of PC1. Furthermore, PC1 avoid an increase

in communication loads with mobile telephone 2.

[0066] Figure 10 shows a flow chart illustration of the disconnection judging process. Connection manager 73 of PC 1 monitors the connection state of a radio link with mobile telephone 2, based on a notice from the Bluetooth driver 74 (S110). Connection manager 73 determines whether the radio link has disconnected (S111). When the radio link has disconnected, connection manager returns to S110 in order to continue monitoring the connection state of the radio link. If radio link disconnection is detected, however, connection manager 73 progresses to S112. At S112, service manager 72 identifies a device address for the disconnected link (S112), and connection manager 73 monitors a radio link connection state by reading out the disconnection judging conditions in connection control information 79 associated with the device address (S113). When the number of detected connection request is less than M, connection manager 73 returns to S113 in order to continue monitoring the connection state of the radio link. When the number becomes M times, the process progresses to a step S114. When the number of detected connection request is less than M, connection manager 73 confirms disconnection of the radio link, because no response was received from a target device. Service manger 72 unloads service information from temporary memory area 85 (S115). By performing this control, PC 1 avoids unnecessary loading or unloading of operations of the service information, because connection manager 73 maintains a radio link connection if mobile telephone 2 sends a response within a predetermined time period. As shown in Figure 8, even if, after a radio link is established, mobile telephone 2 temporarily moves outside of a communication range of PC 1, connection manager 73 will maintain a radio link connection if mobile telephone 2 sends a response within a predetermined time. Thus, PC 1 also avoid an increase of processor loads and can further avoid an increase of radio-communications load with mobile telephone 2.

[0067] As explained above, embodiments consistent with the present invention enable a user to flexibly setup the connection or disconnection judgment conditions of the radio link state. As a result, it is possible to increase communications processing performance without increasing the processing load of the host device or the communication load due to a target device.

[0068] In the above embodiment, the connection condition and disconnection condition of the radio link state was determined based on the number of times a connection request are issued within a predetermined time. However, it is also possible to determine a radio link state based on an intensity of a radio wave. For example, in an embodiment of the present invention, a user may setup a power level of the radio wave. In other words, by gradually changing the power level pf the radio wave, a user may define the detection range of PC1 by the boundaries 1, 2, and 3, as shown in Fig. 8. Here, the radio wave detection range of the standard power level 2 is limited to boundary 2.

[0069] When mobile telephone 2 approaches PC1 in a direction defined by locus A, if PC 1 performs device detection at each stage from a boundary 1 (power level 1) to a boundary 3 (power level 3), PC 1 loads service information by determining whether mobile telephone 2 desires to establish a radio link connection to PC1. On the other hand, when PC 1 does not detect a device between to a boundary 1 (power level 1) and boundary 2 (power level 2), as shown by the direction traveled along locus B, PC 1 does not load the service information by determining that mobile telephone 2 has only temporarily came near to PC1.

[0070] In another example, when mobile telephone 2 travels in a direction away from PC1 as shown by locus C, PC 1 determines that mobile telephone 2 has intentionally separated from PC1. As a result, PC 1 disconnects the radio link. Moreover, service manager 72 unloads the service information from temporary memory area 85. When mobile telephone 2 travels in a direction away from PC 1 to a location outside of boundary 2 (locus D), PC 1 determines that the mobile telephone 2 temporarily separated from PC1. As a result, PC 1 does not disconnect the radio link.

[0071] Although an embodiment has been disclosed that includes the loading/unloading control of service information as it relates to PC1, it should be apparent that this process might also be applied to mobile telephone 2. Moreover, it should be understood that this process is not limited to device such as PC and mobile telephone. But the loading/unloading of service information consistent with the present invention may be applied to various other electrical devices having a radio resource that is exclusively used between a communication channel and where a connection is controlled by inserting a communication channel into a control channel for the devices.

[0072] As explained above, embodiments consistent with the present. Invention can prevent unnecessary loading and unloading of service information processes because it is possible to flexibly set up the connection judgment conditions of the host device as they relate to the radio link. As a result, communication-processing performance is improved without increasing the processing load of the host device or the communication load of host device with regards to a target device.

Claims

1. A radio communication device on a network for communicating with a target communication terminal on the network, comprising:

   a memory for storing service information so that predetermined functions can be performed over the network with the target communication terminal;

a judging module for judging whether predetermined connection conditions with the target communication terminal are satisfied by repeating a target communication terminal discovery process before establishing radio communications with another target communication terminal; and
a communication control module for executing the predetermined functions with the target communication terminal by reading service information associated with the target communication terminal from the service information memory when the predetermined connection conditions are satisfied.

2. A radio communication device on a network for communicating with a target communication terminal on the network, comprising:

a service information memory for storing service information that corresponds to the target communication terminal so that predetermined functions can be performed with the target communication terminal over the network;
a judging module for judging whether predetermined disconnection discriminating conditions are satisfied by repeating a connection process with the target communication terminal before disconnecting radio communication with the target communication terminal; and
a communication control module for invalidating the predetermined functions associated with the service information that corresponds to the target communication terminal and storing the service information memory when the disconnection discriminating conditions are satisfied.

3. A radio communication device in a network for communicating with a target communication terminal in the network, comprising:

a service information memory for storing service information so that predetermined functions can be performed with the target communication terminal; and
a communication control module for communicating with the target communication terminal by using the service information read out from the service information memory based on communication controlling information that defines discriminating conditions for establishing a new connection with the target communication terminal or disconnecting an existing connection with the target communication terminal.

4. A communication device, comprising:

a radio communication module for exchanging data with a target communication terminal over a network;
a service information memory for storing service information so that predetermined functions can be performed with the target communication terminal;
a communication control information designating module for designating conditions for a newly established radio communication connection with the target communication terminal or for discriminating a disconnection of existing radio communication connection with the target communication terminal;
a memory for storing the designated communication controlling information by the communication control information designating module; and
a communication control module for determining whether the radio communication with the target communication terminal is in a connection status or in a disconnection status based on the stored communication controlling information stored in the memory, and performing communication through the radio communication module by using service information read from the service information memory in accordance with the discrimination.

5. A radio communication device in a network that exchanges service information with a target communication terminal in the network for performing predetermined functions, the radio communication device comprising:

a service memory for storing the service information;
a temporary memory for temporarily storing the service information used to establish communications with the target terminal;
a first module for transferring the service information from the service memory to the temporary memory when a radio communicating connection for the target communication terminal has been established, and for transferring the service information from the temporary memory to the service memory when the radio communication with the target communication terminal has been disconnected based on communication controlling information used for discriminating between a newly established radio communication connection with the target communication terminal and a disconnection of an existing radio communication connection with the target communication terminal; and
a radio communication control module for performing the predetermined functions with the target communication terminal when the serv-

ice information stored in the temporary memory.

6. A communication device, comprising:

a radio communication module for exchanging data with a target communication terminal through radio;
a memory for storing service information so that predetermined functions can be performed with the target communication terminal;
a temporary memory for temporarily storing service information used in an established target communication terminal for communication;
a designating module for designating communication controlling information in order to define conditions for discriminating between a newly established radio communication connection with the target communication terminal or a disconnection of an existing radio communication connection with the target communication terminal;
a memory for storing the communication controlling information designated by the designating module;
a discriminating module for determining a status of the radio communication connection with a target communication terminal is a connection status or a disconnection status based on the communication controlling information in the communication controlling information memory, and transferring the service information from the service memory to the temporary memory mechanism when the status of the radio communication connection with the target communication terminal is the connection status, and transferring the service information from the temporary memory when the status of the radio communication connection with the target communication terminal is the disconnection status; and
a radio communication control module for performing the predetermined functions with the target communication terminal when the service information is stored in the temporary memory.

7. The communication device according to one of claims 3 to 6, wherein:

the communication controlling information includes connection discriminating conditions based on the number of times a detecting command for detecting the target communication terminal issues during a predetermined period and disconnection discriminating conditions based on the number of times a confirming command for confirming the connection to the target communication terminal issues during the predetermined period.

8. The communication device according to one of claims 3 to 6, wherein:

the communication controlling information includes connection and disconnection discriminating conditions that define a variation status of the communication connection for indicating a communication connection or a disconnection to the target terminal, the variation status is designated based on a power level of radio waves measured within the predetermined period.

9. A method for controlling a communication device that exchanges data with a target communication terminal over a radio network when establishing a new radio communication connection between the communication device and a target communication terminal, the communication device having a memory for storing various types of data, the method comprising:

judging whether predetermined connection discriminating conditions are satisfied by repeating a target communication terminal discovery process before performing the predetermined functions; and
performing the predetermined functions through the radio communication connection by extracting required service information from memory to perform the predetermined functions between the communication device and the target communication terminal, the required service information is stored in the memory by executing the predetermined functions with the target communication when the predetermined connection conditions are satisfied.

10. A method for controlling a communication device that exchanges data with a target communication terminal over a network, when disconnecting a radio communication connection established between the communication device and a target communication terminal, the communication device having a memory for storing various types of data, the method comprising:

judging whether disconnection conditions are satisfied by repeating a target communication terminal connection process; and
invalidating the predetermined functions corresponding to executed service information that is stored in the memory so that the predetermined functions between the communication

device and the target communication terminal can be performed when the disconnection discriminating conditions are satisfied.

11. A method for controlling a communication device that exchanges data with a target communication terminal over a network, the communication device having a memory for storing various types of data, the method, comprising:

judging whether a radio communication connection between the communication device and a target communication terminal is in a connection status or in a disconnection status, based on communication controlling information that defines conditions for discriminating between a new radio communication connection established between the communication device and a new target communication terminal, or a disconnection of radio communication connection established between the communication device and the target communication terminal, and

performing radio communication with the target communication terminal by using service information that executes the predetermined functions between the communication device and the target communication term, the service information being stored in the memory based on a discrimination result.

12. A method for controlling a communication device that exchanges data with a target communication terminal over a network, the communication device having a memory for storing various types of data, the method comprising:

storing, in memory, designated communication control information that defines discriminating conditions for discriminating between establishing a new connection between the communication device and a target communication terminal, or disconnection a radio communication connection established between the communication device and the target communication terminal;

judging whether the radio communication connection between the communication device and the target communication terminal is in a connection state or in a disconnection based on the designated communication control information; and

performing radio communication to the target communication terminal by using service information that executes the predetermined functions between the communication device and the target communication terminal, the service information being stored in the memory based on a discrimination result.

FIG.1

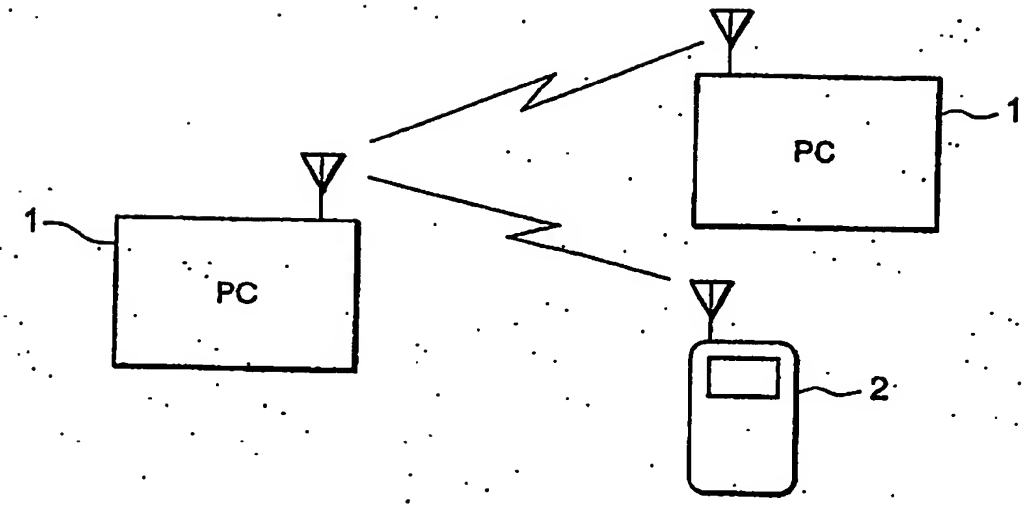

FIG.2

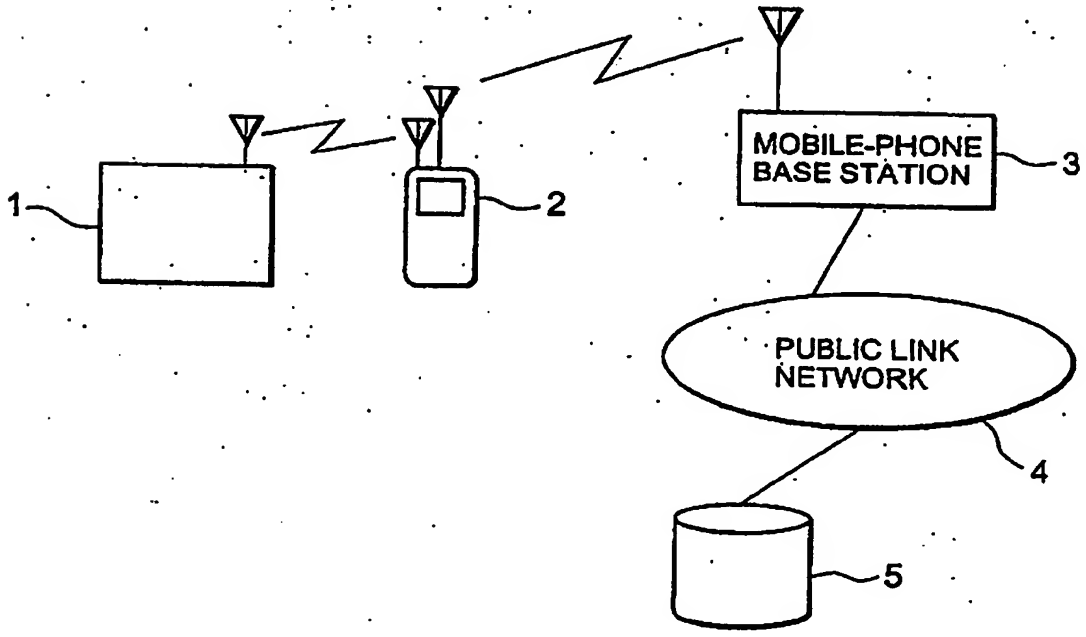

FIG.3

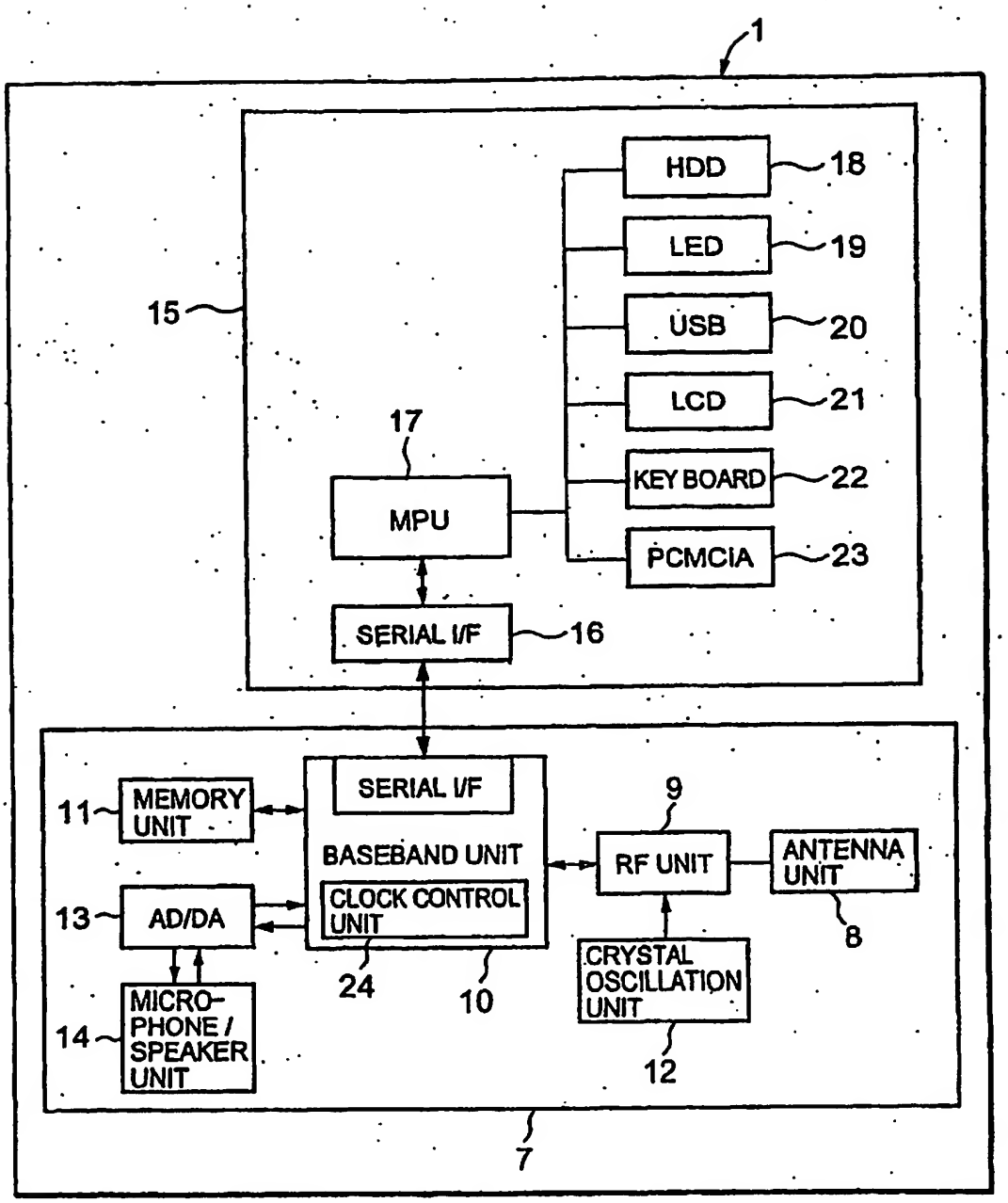

FIG.4

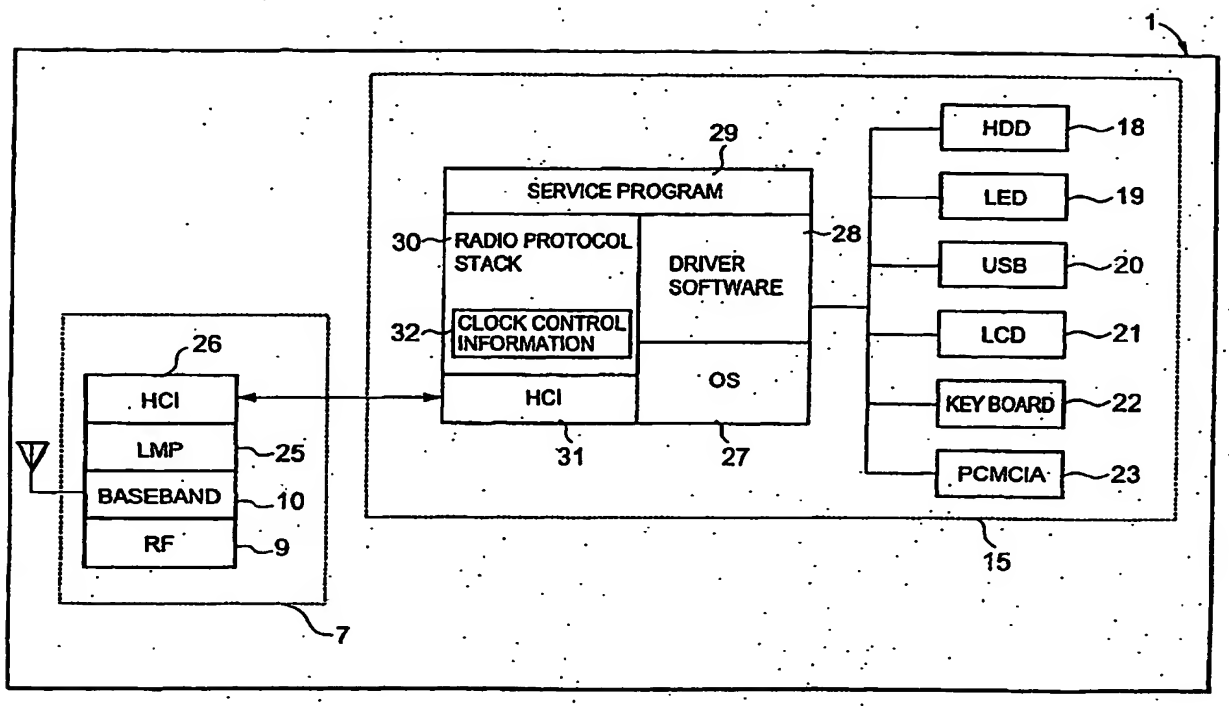

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FIG.5

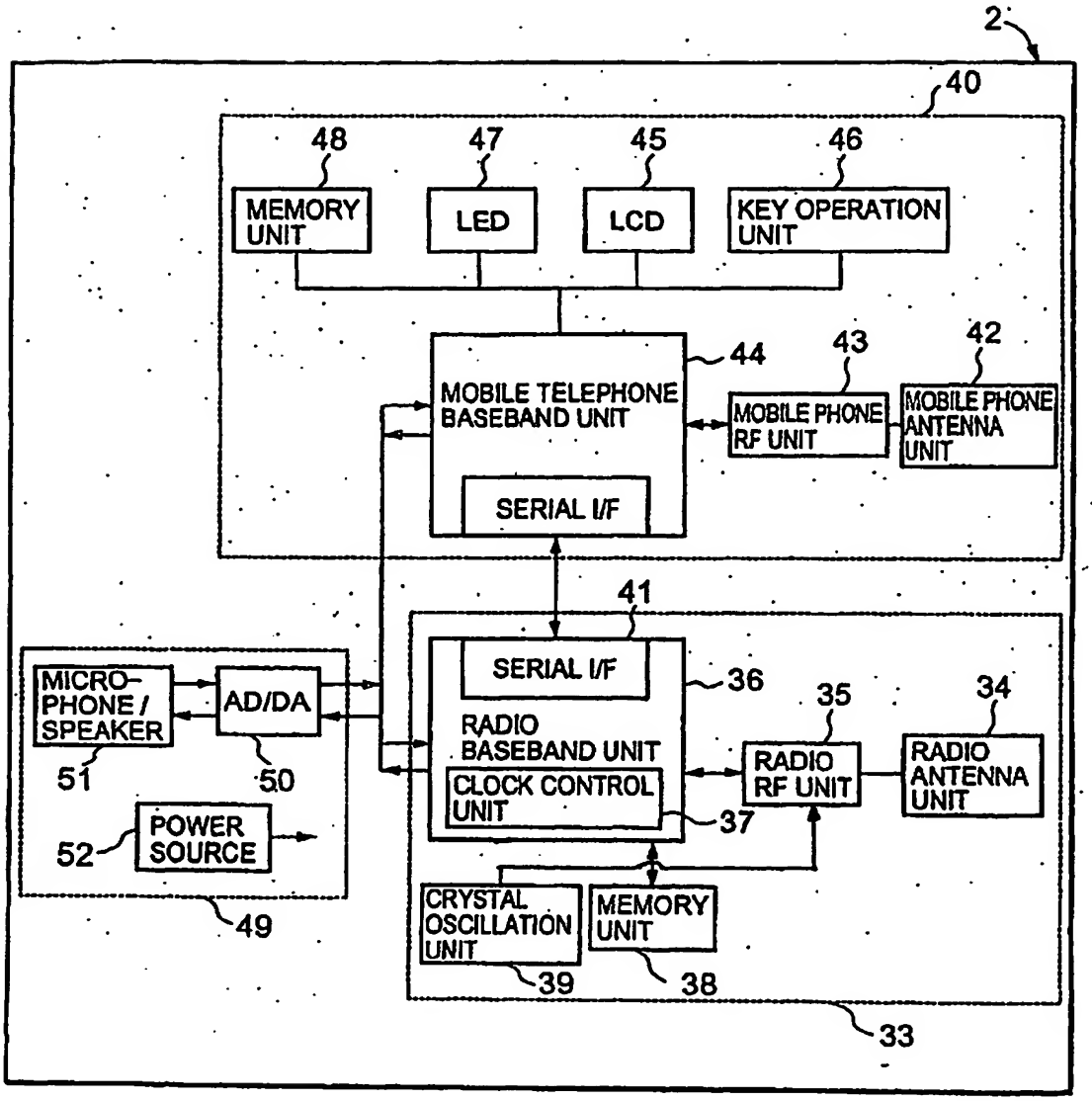

FIG.6

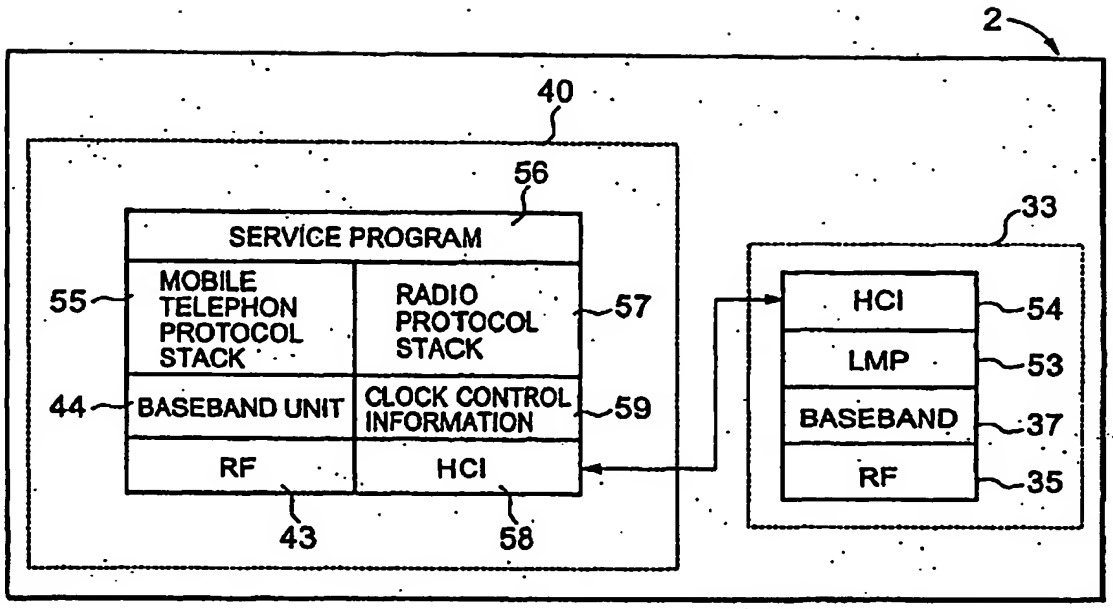

FIG.7

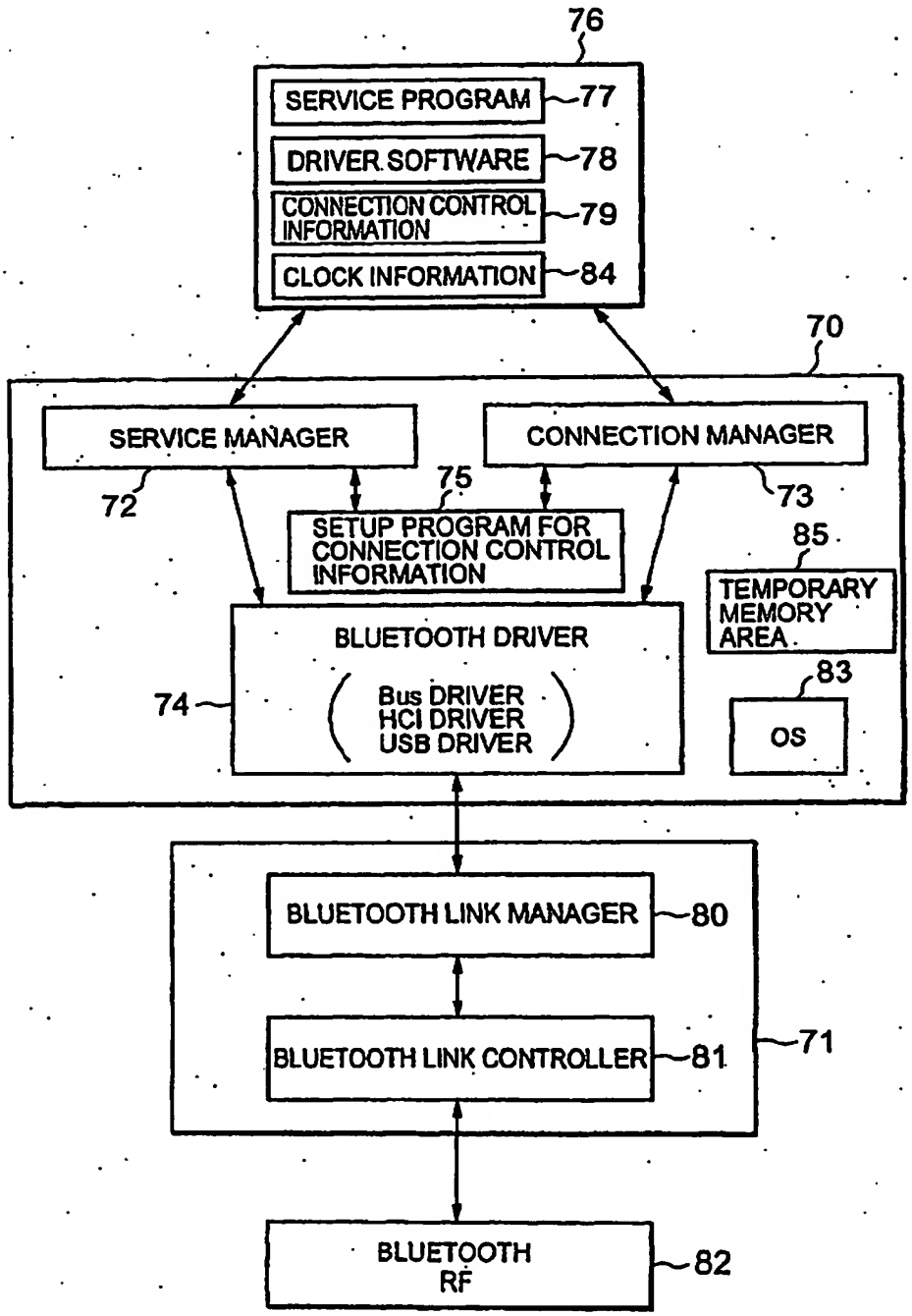

FIG.8

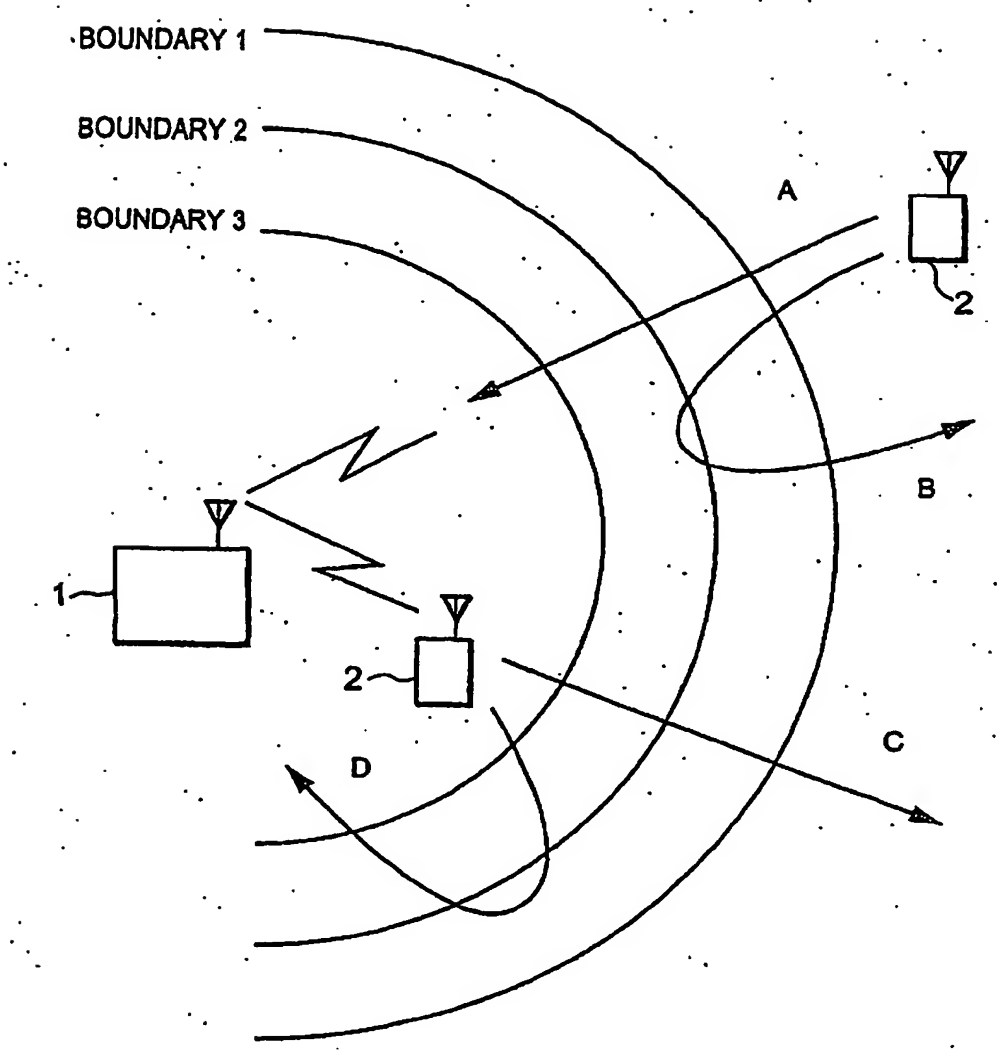

FIG.9

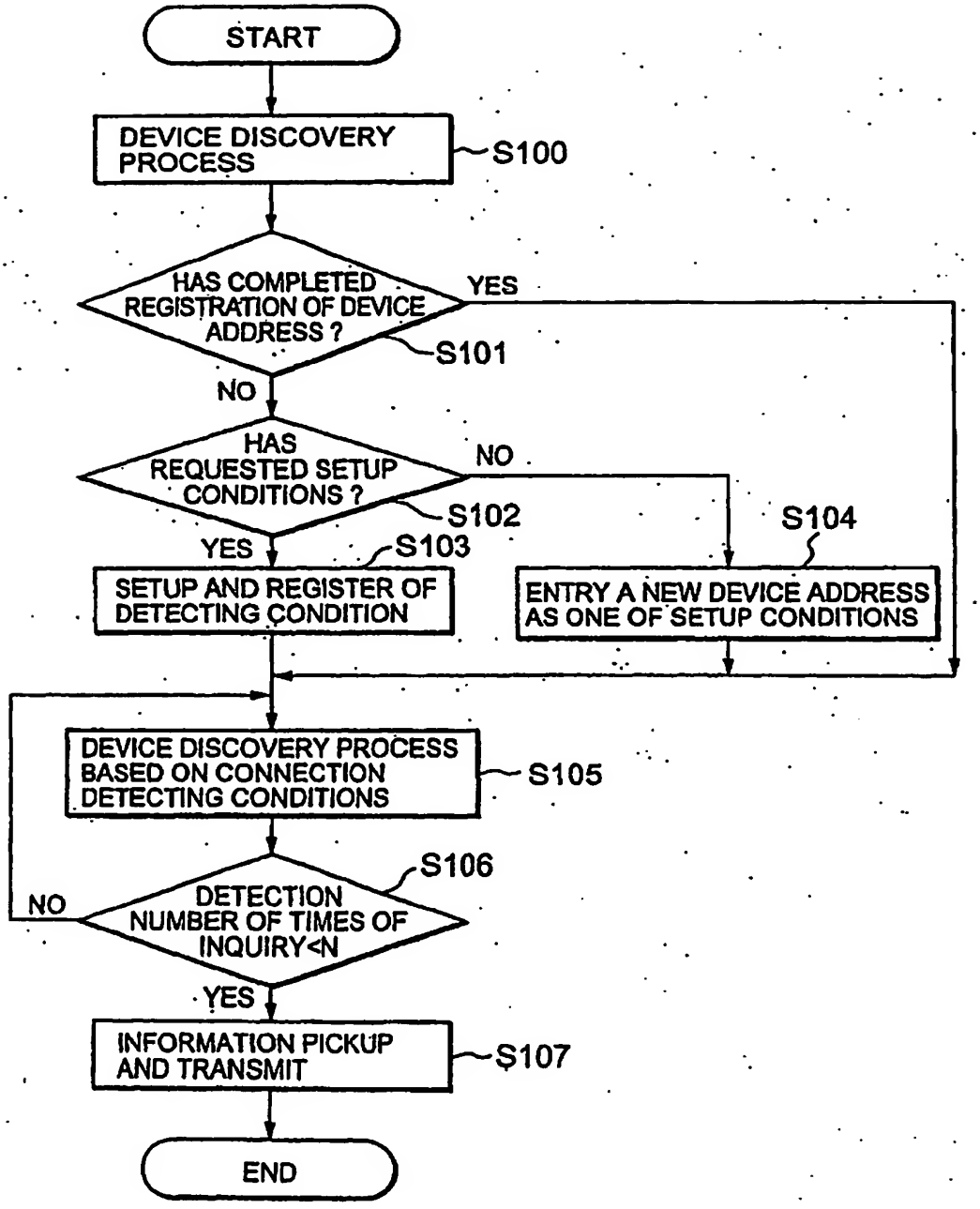

FIG.10

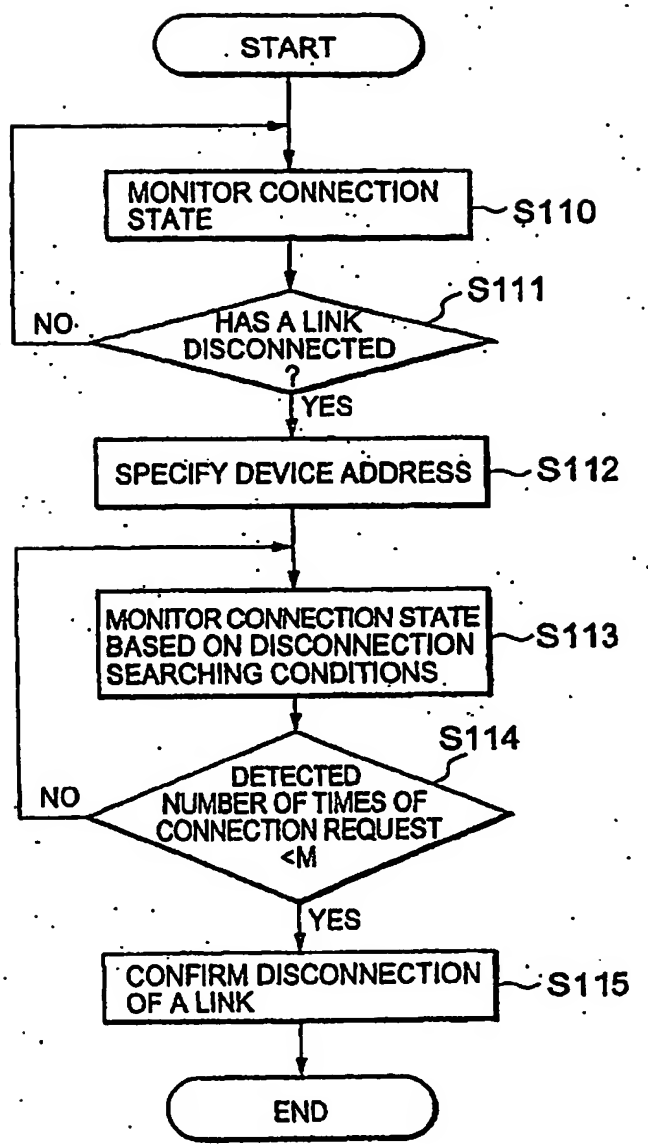

FIG.11

DEVICE ADDRESS	FRIENDLY NAME	CONNECTION JUDGING CONDITIONS			DISCONNECTION JUDGING CONDITIONS				
		ISSUE NUMBER-OF-TIMES OF INQUIRY (n)	INTERVAL (Ti)	DETECTION NUMBER-OF-TIMES MAINTENANCE TIME (Tn)	DETECTION MODE	ISSUE NUMBER-OF-TIMES OF CONNECTION REQUEST (m)	INTERVAL (Tj)	DETECTION NUMBER-OF-TIMES MAINTENANCE TIME (Tm)	DETECTION MODE
AAAA	TERMINAL A								
BBBB	TERMINAL B								
CCCC	TERMINAL C								
XXXX	SETUP DEFAULT								

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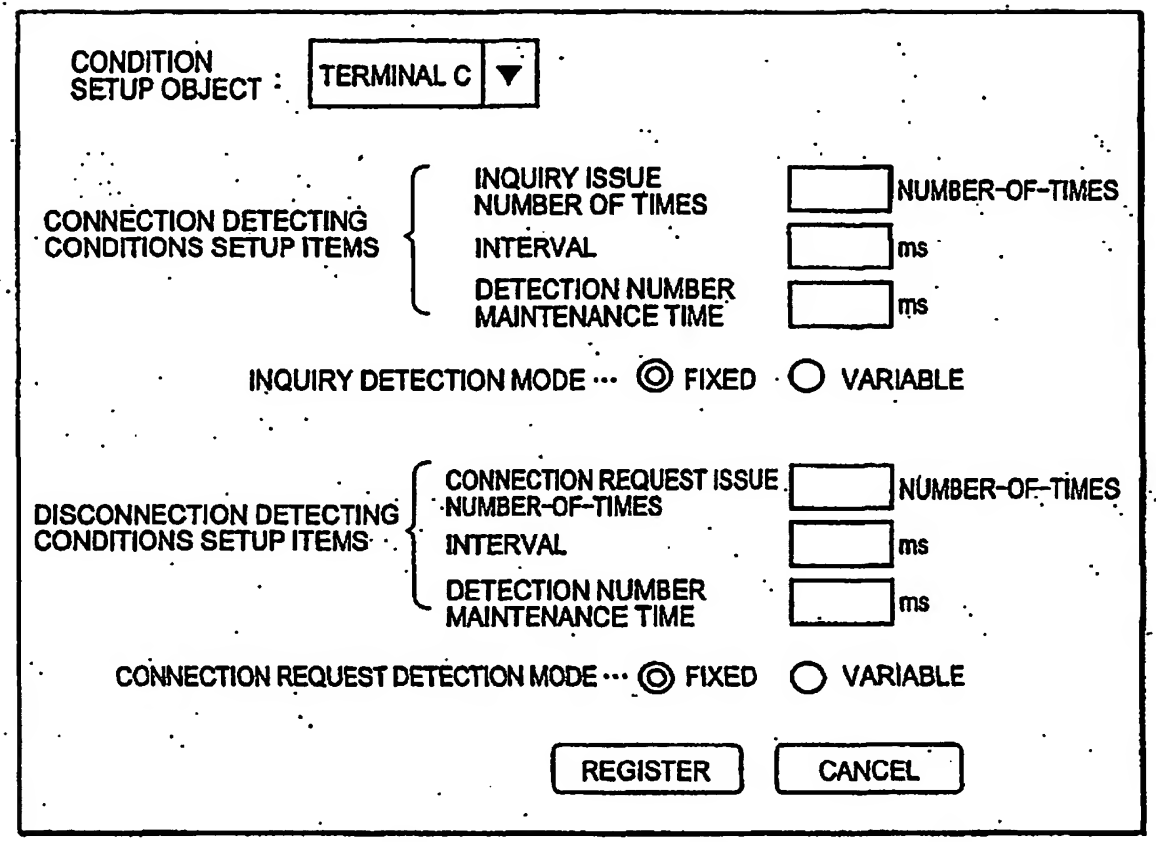
FIG.12



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/05570

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl⁷ H04L29/08, H04L12/28, H04B7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl⁷ H04L29/08, H04L12/28, H04B7/26, G06F13/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho (Y1, Y2) 1922-1996 Toroku Jitsuyo Shinan Koho (U) 1994-2001
Kokai Jitsuyo Shinan Koho (U) 1971-2001 Jitsuyo Shinan Toroku Koho (Y2) 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 10-322773 A (Kenwood Corporation), 04 December, 1998 (04.12.98), Full text (Family: none)	1-12
A	JP 11-225364 A (Nippon Telegr. & Teleph. Corp. <NTT>), 17 August, 1999 (17.08.99), Full text (Family: none)	1-12
A	JP 2000-115189 A (Kokusai Electric Co., Ltd.), 21 April, 2000 (21.04.00), Full text (Family: none)	1-12

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 September, 2001 (13.09.01)	25 September, 2001 (25.09.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)